Active Project (2014 - 2016)

A Reliable, Efficient Cryogenic Propellant Mixing Pump With No Moving Parts, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Refueling spacecraft in space offers tremendous benefits for increased spacecraft payload capacity and reduced launch cost. However, there are several key challenges with space refueling associated with the storage and handling of liquid cryogens in space. To meet these challenges, we propose to develop a reliable, compact, efficient cryogenic mixing pump with no moving parts. The mixing pump will prevent thermal stratification of the cryogen and simplify pressure control for storage tanks. The mixing pump uses an innovative thermodynamic process to generate fluid jets to promote fluid mixing, eliminating the need for mechanical pumps. Our innovative mechanism will be able to self-prime and generate a high-pressure rise. The device will significantly enhance the reliability of pressure control systems for storage tanks. In Phase I, we demonstrated the feasibility of our approach through building and testing a proof-of-concept mixing pump, optimizing the mixing pump design by analysis, and developing a preliminary layout design of a prototype pump. In Phase II, we will build and test a laboratory-scale cryogenic mixing pump, demonstrate its performance in a representative cryogenic environment, and deliver the pump to a NASA research lab for further evaluation.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The technology developed in this project will enable reliable long-term and short-term cryogenic propellant storage in space for refueling. The mixing pump will enable effective pressure control for cryogenic tanks by maintaining a uniform fluid temperature. Its high reliability will significantly enhance the effectiveness of the pressure control mechanism. The device developed in this project can also be used as a two-phase cryogenic pump with no impellers or pistons to enable reliable cryogen transfer for space applications. The technology also has application in

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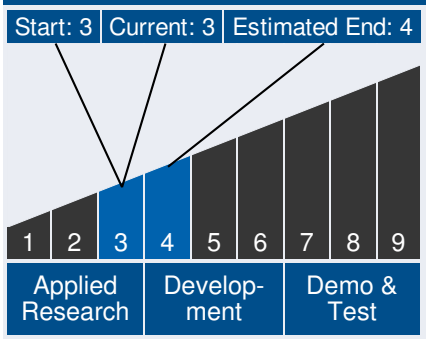
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

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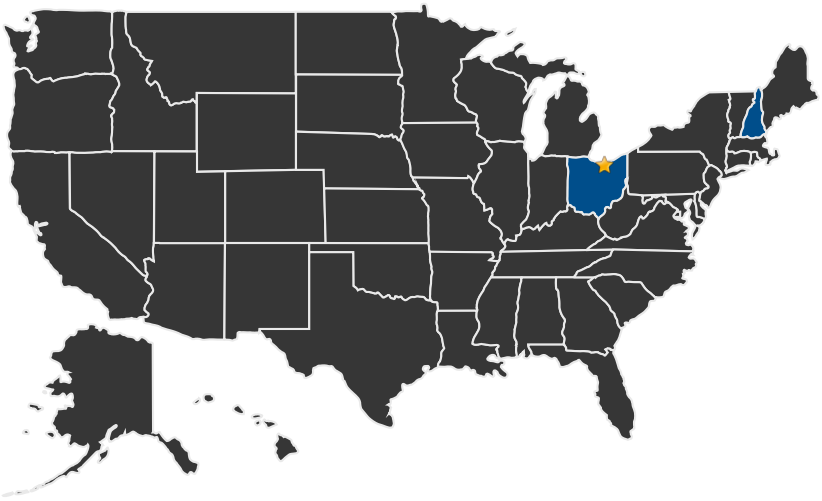
low-G propellant liquid mass gauging by serving as a reliable compression mass gauge.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The technology developed in this project has applications in reliable two-phase pumps for cryogenic fluids and refrigerant flows. Applications include cryogenic two-phase cooling systems for superconductors. The technology also has applications in thermal management systems for advanced electronics and photonics systems, as well as advanced environmental control systems for future military vehicles.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Glenn Research Center

Other Organizations Performing Work:

- Creare, Inc. (Hanover, NH)
- Creare, LLC (Hanover, NH)

Management Team *(cont.)*

Project Manager:
- Robert Thomas

Principal Investigator:
- Weibo Chen

Technology Areas

Primary Technology Area:
In-Space Propulsion Technologies (TA 2)
- Supporting Technologies (TA 2.4)
  - Propellant Storage and Transfer (TA 2.4.2)
    - In-Space Tank-to-Tank Propellant Transfer (TA 2.4.2.3)

Additional Technology Areas:
Thermal Management Systems (TA 14)
- Cryogenic Systems (TA 14.1)
  - Active Thermal Control (TA 14.1.2)
    - Pumps, Circulators, and Fans (TA 14.1.2.6)

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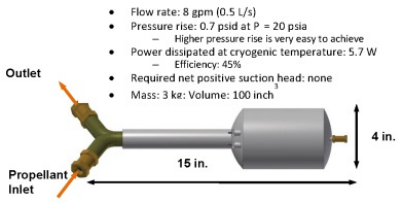
PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23085)

IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

A Reliable, Efficient Cryogenic Propellant Mixing Pump With No Moving Parts

Potential Applications

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